1254 V124 QH1.U55

SMITHSONIAN INSTITUTION.
UNITED STATES NATIONAL MUSEUM.

LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS

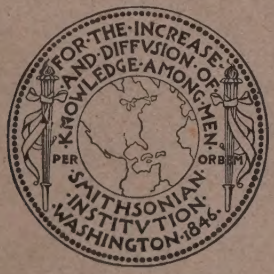
A REVIEW OF THE GYMNODONT FISHES OF JAPAN.

BY

DAVID STARR JORDAN
AND
JOHN OTTERBEIN SNYDER,
Of the Leland Stanford Junior University.

From the Proceedings of the United States National Museum, Vol. XXIV, pages 229–264.

[No. 1254.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1901.

SMITHSONIAN INSTITUTION.
UNITED STATES NATIONAL MUSEUM.

A REVIEW OF THE GYMNODONT FISHES OF JAPAN.

BY

DAVID STARR JORDAN
AND
JOHN OTTERBEIN SNYDER,
Of the Leland Stanford Junior University.

From the Proceedings of the United States National Museum, Vol. XXIV, pages 229-264.

[No. 1254.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1901.

A. REVIEW OF THE GYMNODONT FISHES OF JAPAN.

By David Starr Jordan and John Otterbein Snyder,

Of the Leland Stanford Junior University.

In the present paper is given an account of the Gymnodont fishes (Tetraodontidæ, Tropodichthyidæ, Diodontidæ, Triodontidæ, and Molidæ) known from the waters of Japan. The paper is based on the collections made by the writers in Japan in 1900 under the auspices of the Hopkins Laboratory of Leland Stanford Junior University, and on the collections contained in the United States National Museum. A series of duplicates is in the United States National Museum. The accompanying drawings are the work of Miss Lydia M. Hart and Mr. A. H. Baldwin.

MEASUREMENTS.

The measurements given in this paper, except those quoted from other authors, were made as follows: Length of caudal peduncle, measured from end of base of anal to middle of base of caudal; length of head, from tip of snout to upper edge of gill opening; width of interorbital space, measured on the bony septum between the eyes; length of snout, from tip of snout to orbit; diameter of eye, longitudinal diameter of exposed iris; in numbering the dorsal and anal rays the short anterior rays are included.

Suborder GYMNODONTES.

Plectognaths without a spinous dorsal, with the body short and with the belly inflatable; the scales typically spiniform, with root-like insertions, and with the jaws enveloped in an enamel-like covering, without distinct teeth. This group contains degraded Plectognaths, which have lost the scales, spinous dorsal, and distinct teeth. In the extreme forms the pelvis, ribs, and caudal vertebræ are also lost, the species depending on their dermal armature, leathery skin, or inflatable belly for protection from enemies, while little power of active movement remains. (*γυμνός*, naked; *ὀδούς*, tooth.)

a. Pelvis very long, supporting the fan-shaped ventral area; upper jaw divided by a median suture; lower jaw undivided; skin covered with rough plates; nostrils as usual among fishes.....TRIODONTIDÆ I.

aa. Pelvis and ribs obsolete.

b. Caudal region normally developed, with a caudal peduncle.

c. Upper and lower jaw each divided by a median suture; maxillaries and dentaries each curved outward behind the premaxillaries; ethmoid more or less projecting in front of frontals; postfrontals extending outward at least as far as frontals.

d. Vertebræ comparatively few, 15 to 21 in number; dorsal and anal short, of 7 to 15 rays.

e. Back broadly rounded; frontal bones articulated with the supraoccipital, postfrontals confined to the sides; ethmoid short, narrow, little prominent to view above; vertebræ few; head broad; nostrils various.

TETRAODONTIDÆ II.

ee. Back more or less sharply ridged; frontal bones separated from the supraoccipital by the postfrontals, which meet in the middle; ethmoid prominent above, enlarged and narrowed forward; snout pointed; dorsal and anal very short; nostrils obsolete or very small.

TROPIDICHTHYIDÆ III.

cc. Upper and lower jaw each undivided, the premaxillary and dentary bones coössified into sutureless arches; maxillaries extended laterally behind; body covered with stout, rooted spines.....DIODONTIDÆ IV.

bb. Caudal region of body aborted, the body truncated behind the dorsal and anal; jaws each without median suture.....MOLIDÆ V.

Family I. TRIODONTIDÆ.

Body covered with small, bony, scale-like, partly imbricated laminæ. Abdomen dilatable into a very large compressed pendant sac, kept expanded by a very long pelvic bone; lower part of sac merely a flap of skin, into which the air does not penetrate. Skeleton ossified, the ribs well developed. Dorsal and anal short. Tail long, ending in a many-rayed forked fin. Upper jaw divided by a median suture; lower entire. Nostrils normal, with two openings on each side.

A single known species, representing a transition from the ordinary fishes to the Gymnodont type.

1. TRIODON Reinwardt.

Triodon REINWARDT, Cuvier, Règne Anim., 3d ed., 1829, p. 588 (*bursarius*).

(Characters of the genus indicated above.)

(τρεῖς, three; ὀδούς, tooth.)

1. TRIODON BURSARIUS Reinwardt.

Triodon bursarius REINWARDT, Cuvier, Règne Animal, 2d ed., 1829, p. 588, Sumatra.—BLEEKER, Atlas Gymnodontes, 1867, p. 84, pl. x, fig, 1, Amboyna, Harouka, Banda.—GÜNTHER, Cat. Fish., VIII, 1870, p. 270, Mauritius, India.

Triodon macropterus LESSON, Voy. Coquille, 1830, p. 103, pl. IV, Mauritius.

Head, $3\frac{3}{4}$; depth, with sac, $3\frac{3}{4}$; depth, without sac, $3\frac{1}{2}$; dorsal rays 10; anal rays 9. Eye large, 4 in head; mouth rather large, its cleft as long as eye. Color brown, with a large irregular ocellated black spot

on side of body at base of ventral sac and between pectoral and anal. (Bleeker.)

East Indies, not common; rarely north to Japan; a specimen from Misaki in the Imperial University of Tokyo. Also recorded from Japan by Dr. S. Matsubara. (*Bursarius*, purse-like.)

Family II. TETRAODONTIDÆ.

PUFFERS.

Body oblong or elongate, usually little compressed, sometimes very broad; head and snout broad; belly capable of great inflation; skin scaleless, usually more or less prickly, the spines or prickles usually weak and movable, not rooted; rarely the skin is armed with bony scutes forming a sort of carapace; each jaw confluent, forming a sort of beak, which in each jaw is divided by a median suture; maxillaries curved outward behind the premaxillaries; lips full; nostrils various. Spinous dorsal and ventral fins wanting, the fins composed of soft rays only; dorsal fin posterior, opposite and similar to anal; caudal fin distinct; no ventral fins, the pelvic bone undeveloped; no ribs; pectoral fins short and broad, the upper rays longest; caudal fin and caudal vertebræ normally developed. Medifrontals articulated with the supraoccipital, the postfrontals confined to the sides, the ethmoid more or less projecting in front of frontals; postfrontals extending outward as far as frontals; prosethmoid short and narrow, little prominent to view above; vertebræ few, 7 or 8 + 9 to 13. Gill openings small, placed close in front of pectorals; air bladder present. Fishes of sluggish movements, inhabiting warm seas, noted for their habit of filling the stomach with air. When disturbed they then float on the surface, belly upward. They are not much used as food, even in Japan, the flesh being ill-flavored and sometimes reputed poisonous.

a. Frontal bones expanded sidewise and forming the lateral roofs of the orbits, the postfrontals limited to the posterior portions. Species chiefly marine.

b. Nostril on each side with 2 distinct openings usually in a low tube or papilla; frontal region longer than broad ..... *Spheroides*, 2.

bb. Nostril on each side with a bifid tentacle without distinct opening; frontal region broader than long; fins rounded ..... *Tetraodon*, 3.

2. SPHEROIDES Lacépède.

SWELL-FISHES.

Crayracion Klein, Missus 1742 (*spengleri;* nonbinomial).

Les sphéroides Lacépède, Hist. Nat. Poiss., II, 1798, p. 1 (French name only; *tuberculé*).

Spheroides Duméril, Zoologie Analytique, 1806, p. 342 (*tuberculatus=spengleri*, from a drawing showing a front view).

Orbidus Rafinesque, Analyse de la Nature, 1815, p. 90 (substitute for *Les sphéroides* Lacépède).

Sphæroides Lacépède, Pillot Edition, Hist. Nat. Poiss., VI, 1831, p. 279 (*tuberculatus=spengleri*).

Lagocephalus SWAINSON, Nat. Hist. Class. Fishes, II, 1839, pp. 194, 328 (*pennanti=lagocephalus*).

Cirrhisomus SWAINSON, Nat. Hist. Class. Fishes, II, 1839, pp. 194, 328 (*spengleri*).

Cheilichthys MÜLLER, Abhandl. Akad. Wiss. Berlin, 1839 (1841), p. 252 (*testudineus*).

Physogaster MÜLLER, Abhandl. Akad. Wiss. Berlin, 1839 (1841), p. 252 (*lunaris*) (name preoccupied).

Gastrophysus MÜLLER, Wiegmann's Archiv., IX, 1843, p. 330 (*lunaris*).

Holacanthus GRONOW, Syst. Nat., Ed. Gray, 1854, p. 23 (includes all *Tetraodontidæ* and *Diodontidæ*); name preoccupied.

Anchisomus KAUP MS., Richardson, Voyage Herald, 1854, pp. 156, 162 (*spengleri*, etc.).

Les stenometopes (*Stenometopus*) BIBRON, Revue de Zoologie, 1855, p. 279 (*testudineus*, etc.).

Geneion BIBRON, Revue de Zoologie, 1855, p. 279 (*maculatum*).

Catophrynchus BIBRON, Revue de Zoologie, 1855, p. 279 (*lampris*).

Les promecocephales (*Promecocephalus*) BIBRON, Revue de Zoologie, 1855, p. 279 (*argentatus*).

Apsicephalus HOLLARD, Études sur les Gymnodontes, 1867, p. 324 (*testudineus*, etc.).

Liosaccus GÜNTHER, Cat. Fish., VIII, 1870, p. 297 (*cutaneus*).

Body oblong or elongate; skin variously prickly or smooth, sometimes with cirri. A single, short, simple nasal tube on each side, with 2 rather large openings near its tip, the tube sometimes reduced to a mere rim. Dorsal and anal fins of 6 to 15 rays each; caudal truncate, rounded, or concave. Vertebræ 18 to 21. Frontal bones expanded sidewise and forming the lateral roof of the orbit, the postfrontals limited to the posterior portions. Species very numerous in warm seas. The group contains 2 or 3 strongly marked subgenera, which would be regarded as distinct genera if only extremes were considered. But the transition is very gradual from *Lagocephalus*, with elongate body, silvery skin, prominent lateral fold, long falcate dorsal and anal, with forked caudal, to typical *Spheroides*, with short fins and the form of *Tetrodon*. Most Japanese species belong to the subgenus *Lagocephalus*.

(σφαίρα, sphere; εἶδος, resemblance; the genus based on a front view, in which the fish was represented as spherical.)

a. LAGOCEPHALUS. Dorsal and anal each with 12 to 14 rays, the fin usually acute at tip; nostril short, scarcely produced as a papilla.

b. Caudal fin more or less distinctly lunate; dorsal and anal falcate; mucous tubes on head distinctly developed.

c. Lateral fold on sides of body evident.

d. Back and belly distinctly prickly, the prickles sometimes embedded in the skin.

e. Back with rather large scattered black spots; sides with a silvery band; gill opening black ..... *sceleratus*, 2.

ee. Back nearly plain gray, without spots; sides silvery; gill opening pale. *spadiceus*, 3.

eee. Back with close-set black dots, coarse or fine; sides not silvery; prickles very small, often entirely hidden ..... *stictonotus*, 4.

dd. Back and belly without prickles, or very nearly so; color plain brown above, without dark spots; sides silvery; lateral fold very distinct ..... *inermis*, 5.

cc. Lateral fold obsolete; color plain brown, a dark blotch behind pectoral; skin without prickles ..... *porphyreus*, 6.

bb. Caudal fin subtruncate or rounded; dorsal and anal less falcate; lateral fold usually obscure.

f. Spots or stripes on body blackish, distinctly darker than the ground color, and well defined.

g. Back and belly with strong prickles; region behind pectoral with a black blotch or black streaks; form robust; ground color brownish, the fins reddish.

i. Side of tail without dark horizontal stripes; a large black ocellus behind pectoral, another at base of dorsal ..... *rubripes*, 7.

ii. Side of tail with two or three black horizontal stripes; back plain or with dark blotches ..... *xanthopterus*, 8.

gg. Back and belly without prickles; no distinct black blotch behind pectoral or at base of dorsal, the back and sides covered with round black spots; lateral fold evident.

j. Caudal fin blackish, without bars or spots.

k. Caudal fin rounded; spots on back sparse on a brownish ground color ..... *pardalis*, 9.

kk. Caudal fin truncate; spots on back close-set on a pale ground ..... *abbotti*, 10.

jj. Caudal fin barred, the bars formed of black spots on the rays; sides with a gray lateral band and large dark spots and vermiculations above it ..... *exascurus*, 11.

ff. Spots on body pale, light gray, or white (sometimes forming vermiculations about the darker ground color); a large blackish blotch behind pectoral and another below dorsal.

l. Back and belly distinctly prickly.

m. Black blotch behind pectoral connected by an ocellated black bar over the back with its fellow .. *ocellatus*, 12.

mm. Black blotch behind pectoral not connected with its fellow; back with spots and streaks of gray. *alboplumbeus*, 13.

ll. Back and belly without prickles or very nearly so; pectoral blotches not connected.

n. Spots on back mostly broader than the interspaces, dull gray in color.

o. Pale spots vermiculate, irregular in form; bony interorbital broad, 2½ in head .... *vermicularis*, 14.

oo. Pale spots rounded in the young, becoming with age pale areas which coalesce about round spots of the olivaceous ground color; bony interorbital narrow, 3½ in head ..... *borealis*, 15.

nn. Spots on back pure white, sharply defined, mostly narrower than the interspaces ..... *niphobles*, 16.

aa. Dorsal and anal short, rounded in outline, each of 6 to 10 rays; nostrils in a prominent tube; caudal rounded; no lateral fold.

p. SPHEROIDES. Body above and below closely prickly; back with irregular dark blotches. *richei*, 17.

pp. LIOSACCUS. Body entirely smooth, back and sides chocolate brown, with irregular scattered black streaks and spots ..... *chrysops*, 18.

2. SPHEROIDES SCELERATUS (Forster).

GINFUKU (SILVER PUFFER).

Tetraodon sceleratus (Forster) GMELIN, Syst. Nat., 1788, p. 1444 (Atlantic and Pacific oceans).—SCHNEIDER, Syst. Ichth., 1801, p. 506, fair description after Forster.—GÜNTHER, Cat. Fish., VIII, 1870, p. 276, Zanzibar, Ceylon, Madras, Amboyna, Philippines, Formosa, South Australia.—ISHIKAWA, Prel. Cat., 1697, p. 2, Kagoshima.

Tretrodon argenteus LACÉPÈDE, Ann. Mus. d'Hist. Nat., 1804, p. 211, pl. LVIII, fig. 2, New Holland.—SCHLEGEL, Fauna Japonica, Poiss., p. 275, pl. CXXI, fig. 2, Nagasaki.—BLEEKER, Atlas Gymnodontes, p. 64, pl. V, fig. 1, Java, Bali, Singapore, Bangka, Biliton, Borneo, Celebes, Amboyna.

Tetrodon argyropleura BENNETT, Proc. Comm. Zool., II, 1832, p. 184.

Tetrodon argentatus BLYTH, Prodr. Fauna, Zeyl., p. 49, Ceylon.

Tetrodon bicolor BREVOORT, Exped. Japan, 1856, p. 283, Shimoda.

Head $3\frac{1}{3}$; depth 4; dorsal rays 12; anal rays 12. Head and back covered with fine shagreen; abdomen with small, three-rooted spines; side naked. Body very slender, the tail depressed, the lateral fold distinct from the chin to the tail; dorsal and anal falcate; caudal lunate, with pointed angles; pectoral with its upper angle sharp. Greenish, with round scattered black spots above, not confluent and all smaller than pupil; sides with a distinct silvery band, below which is a brownish band which runs around the chin; a triangular silvery area before eye; gill opening jet black. Vertebræ $7 + 10 = 17$. Length $2\frac{1}{2}$ feet. (Günther.)

East Indies, north to Japan (Nagasaki, Kagoshima, Shimoda); rather scarce; not seen by us. (*Sceleratus*, rascally, the flesh being reputed poisonous.)

3. SPHEROIDES SPADICEUS (Richardson).

SABA-FUKU (MACKEREL PUFFER).

Tetrodon lunaris[1] SCHLEGEL, Fauna Japonica, 1847, p. 277, pl. CXXII, fig. 1, Nagasaki (probably not of Schneider, 1801).—NYSTROM, Handl. Svensk. Vet. Ak., 1887, p. 48, Nagasaki.—ISHIKAWA, Prel. Cat., 1897, p. 1, Boshu, Tokyo.

Tetrodon spadiceus RICHARDSON, Voy. Sulphur, Ichth., 1844, p. 123, pl. LVIII, figs. 4, 5, Canton.—BLEEKER, Atlas Ichth. Gymnodontes, p. 64, pl. III, fig. 1, Java, Sumatra, Banka, Borneo, Celebes, Amboyna.

Tetrodon lunaris var. *spadiceus* GÜNTHER, Cat. Fish., VIII, 1870, p. 275, Vizagapatam, Malabar, Borneo, Philippines, China.

Head $3\frac{1}{2}$ in length; depth $3\frac{2}{3}$; depth of caudal peduncle 5 in head; eye $4\frac{1}{3}$; snout 2; interorbital space $2\frac{1}{2}$; dorsal rays 12; anal rays 12. Body rather elongate, the caudal peduncle narrow, cylindrical; dorsal contour little elevated; head flat above, the interorbital space

[1]According to Dr. Bleeker, *Spheroides spadiceus* is distinguished constantly from *S. lunaris* (Schneider) of the East Indies by the longer body, the relatively smaller head, the smaller eyes, the rounded and not angular form of the subocular part of lateral line, and by the smoothness of the region behind the tip of the pectoral. One of our specimens from Nagasaki has the subocular part of the lateral line evenly rounded, while the others have it quite angular.

slightly concave, the distance between eyes about equal to twice their diameter; snout rather long, about twice the diameter of eye. Nostrils separate, not tubular, in a shallow, oval depression, their distance anterior to eye about equal to half the space between eye and upper edge of gill opening. Teeth pointed in front, their cutting edges concave, the groove between upper teeth pronounced, bordered on each side by a ridge. Gill opening extending a little above base of pectoral, the inner or secondary flap completely hidden by the outer.

A line of mucous pores extending from the upper, anterior part of snout backward below eye, curving upward behind eye, passing in a broad curve above the pectoral, bending downward in the region of the dorsal, and running along middle of caudal peduncle to base of caudal fin; a transverse line extending across nape, connecting the lateral lines and forming the posterior boundary of a quadrangular space, the upper and anterior boundary lines of which unite to pass forward over the eye, then downward just posterior to the nostrils to join the lateral line; a branch line extending from snout, bending downward behind mouth to chin, then running backward along breast and disappearing on belly; each line composed of two rows of minute papillæ. A small but distinct ridge passing along lower side of head, below base of pectoral, curving upward over base of anal and extending along lower part of caudal peduncle to base of caudal fin. A dorsal patch of small prickles extending backward from nostrils, the posterior border acutely convex in shape, ending at a point above tips of pectorals; in one specimen a few prickles grow back almost to insertion of dorsal; throat, breast, and belly with a patch of prickles, larger and farther apart than those above, not extending to the vent.

Dorsal and anal somewhat falcate, the latter inserted on a vertical passing through a point a little anterior to the middle of the former; the dorsal slightly higher than the anal, 1½ in head. Caudal lunate, the upper lobe slightly longer than lower. Edge of pectoral straight.

Color gray or faintly mottled above; silvery on lateral and ventral parts; fins pale; edges of dorsal and caudal darker.

Here described from Nagasaki specimens. An example from Tokyo has a brownish spot on upper part of base of pectoral.

East Indies, north to Japan; rather common. Our specimens from Tokyo (2) and from Nagasaki (3). (*Spadiceus*, nut-brown.)

4. SPHEROIDES STICTONOTUS (Schlegel).

Tetrodon stictonotus Schlegel, Fauna Japonica, 1847, p. 280, pl. cxxvi, fig. 1, Nagasaki. Günther, Cat. Fish., VIII, p. 281, Nagasaki. Nystrom, Hand. Svensk. Vet. Ak., 1887, p. 48, Nagasaki.—Ishikawa, Prel. Cat., 1897, p 2, Tokyo.

Gastrophysus stictonotus Bleeker, Act. Soc. Indo-Nederl., Japan, IV, p. 30.

Head 3⅜ in length; depth 4½; depth of caudal peduncle 3⅗ in head; eye 7½; snout 2½; interorbital space 2½; dorsal rays 16; anal rays 14.

Body very long, the head much shorter than the distance between nape and insertion of dorsal; upper contour of head evenly rounded, the back not much elevated; caudal peduncle somewhat compressed, its depth $3\frac{2}{3}$ in head, its length about equal to that of head. Eye rather small, about $2\frac{3}{4}$ in snout. Interorbital space slightly convex, the distance between eyes $4\frac{1}{3}$ times their longitudinal diameter. Nostrils

FIG. 1.—SPHEROIDES STICTONOTUS (Nagasaki).

separate, located almost transversely on an oval elevation a little larger than pupil. Teeth bluntly pointed in front; the cutting edges concave, the groove between the teeth scarcely perceptible; ridges on either side of groove not prominent; upper and lower teeth of about the same width. Inner or secondary flap at gill-opening protruding.

Lines of mucous pores on body like those of *S. rubripes*. Lateral

FIG. 2.—SPHEROIDES STICTONOTUS (Hakodate).

fold evident, though not very prominent. Skin with small prickles, those on the upper anterior parts completely embedded; snout, sides of head, chin, upper and lower parts of caudal peduncle, and a narrow area along side of body naked.

Dorsal inserted a little in advance of anterior rays of anal; both fins falcate, of about equal height, $1\frac{2}{3}$ in head, the anterior rays shortened,

the fourth or fifth ray longest. Caudal truncate, the upper and lower rays slightly lengthened at tips. Posterior edge of pectoral straight or slightly convex; length 2 in head.

Color dark slaty gray above, belly white; sides of head closely sanded with black points; rest of body almost uniformly colored, without distinct points; dorsal and caudal black, the tip darkest.

Schlegel's description and figure of the species is founded on a stuffed skin, which accounts for the prominence of the prickles and the shortening of the space between the head and the insertion of the dorsal fin.

Coasts of Japan; here described from a fine specimen about 480 mm. long from Hakodate.

Two specimens, about 350 mm. long, from Misaki, agree with the above description except that they are very finely marbled above. Another of about the same length from Nagasaki is also finely marbled; in some places entirely black. (*στικτός*, spotted; *νῶτος*, back.

5. SPHEROIDES INERMIS (Schlegel).

KANABUKU (METAL PUFFER).

Tetrodon inermis SCHLEGEL, Fauna Japonica, 1847, p. 278, pl. CXXII, fig. 2, Shimabara.

Head 3½; depth 3; dorsal rays 12; anal rays 12. Body rather elongate, the lateral fold distinct; back entirely smooth; belly with small spines; fins rather falcate; the caudal lunate, with pointed angles.

Color olive-green, unmarked; sides and below silvery. (Schlegel.)

Southern Japan, once taken at Shimabara in Kiusiu, not seen by us; evidently very close to the American species *S. laevigatus*. (*inermis*, unarmed.)

6. SPHEROIDES PORPHYREUS (Schlegel).

NAMERABUKU (SLEEK PUFFER).

Tetrodon porphyreus SCHLEGEL, Fauna Japonica, 1847, p. 282, pl. CXXI, fig. 1, Nagasaki.—GÜNTHER, Cat. Fish., VIII, 1870, p. 287 (after Schlegel).—NYSTROM, Handl. K. Svensk. Vet. Akad., 1887, p. 48, Nagasaki.

Head 2⅝; depth 3; dorsal rays 14; anal rays 12. Body rather stout, the tail shortish, the distance from vent to base of caudal less than half the distance to tip of snout; lateral fold wanting or reduced to a trace; skin everywhere smooth, the back with scattered papillæ; fins falcate, the caudal lunate, the anal 1⅛ in head. Color purplish brown above, white below; a large blackish blotch behind pectoral; papillæ pale. (Schlegel.)

Coast of Kiusiu; not seen by us. Said to be taken at Nagasaki in winter. (*πορφύρεος*, purple.)

7. SPHEROIDES RUBRIPES (Schlegel).

MABUKU (TRUE PUFFER), TORABUKU (TIGER PUFFER), YANAGIBUKU (WILLOW PUFFER).

Tetrodon rubripes SCHLEGEL, Fauna Japonica, 1847, p. 283, pl. CXXIII, fig. 1, Nagasaki.—GÜNTHER, Cat. Fish., VIII, 1870, p. 279, Nagasaki.—NYSTROM, Handl. Svensk. Vet. Ak., 1887, p. 48, Nagasaki.—ISHIKAWA, Prel. Cat., 1897, p. 2, Rikiuzen, Kaga.

Gastrophysus rubripes BLEEKER, Act. Soc. Indo-Nederl., Japan, VI, p. 68.

Lagocephalus rubripes JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 360, Tokyo.

Head 3 in length; depth $3\frac{1}{2}$; depth of caudal peduncle $3\frac{3}{5}$ in head; eye 8; snout $2\frac{1}{5}$; interorbital space $2\frac{2}{5}$; dorsal rays 14; anal rays 13.

Body rather stout, the caudal peduncle not very slender, compressed laterally. Head large, nearly square, in transverse outline, its length almost equal to distance between head and insertion of dorsal; interorbital space broad, flat. Eye small, $3\frac{1}{2}$ in snout. Nostrils separate, located almost transversely in an oval elevation; about an eye's diameter from eye. Teeth rather pointed anteriorly, the cutting edge concave; groove between the upper ones well defined, the ridges prominent; lower teeth wider than the upper ones. Inner flap of gill opening exposed.

Latter fold of body rather distinct posteriorly. A line of mucous pores extends from a point on the snout backward, below and close to the eye, bends upward behind the eye to a point above the gill-opening, from which point a branch crosses the occiput to meet the line of the opposite side; thence backward along the upper part of the side of body and caudal peduncle and slopes downward to middle of base of caudal fin; from a point behind eye a branch runs downward, disappearing on the throat; from behind the origin of this branch a line extends upward, bending forward above the eye and downward posterior to the nostril, joining the line first mentioned; no inclosed quadrangular space behind eye; snout with a transverse line above; a line passes backward from chin on each side and disappears on the breast; an indistinct line extends from below pectoral backward above base of anal to caudal fin. Back with rather small prickles from interorbital space to near insertion of dorsal fin; under parts with slightly larger prickles from just behind chin to vent; other parts of head and body naked.

Dorsal and anal rather pointed, not falcate, both of about the same height, 2 in head; dorsal inserted a little in advance of anal. Caudal truncate, $1\frac{2}{3}$ in head. Pectoral convex posteriorly, about 3 in head.

Color dark brown above, white or yellowish below; a large black ocellated blotch behind the pectoral; another at base of dorsal, extending on the fin; two or three smaller blotches faintly ocellate behind the pectoral blotch; caudal blackish; lower fins orange in life; no horizontal stripes on sides of body.

Described from a specimen about 350 mm. long, collected at Wakanoura. Younger examples about 200 mm. long, have small pale spots on the back and have the post-pectoral row of faintly ocellate spots absent; otherwise they are colored as the adult, with the exception that the large ocellate spot behind pectoral is more conspicuous. Young of 70 or 80 mm. length, gray, with five dark cross bands above, besides dark clouds; black blotches obscure.

Length 450 to 500 mm. Coast of southern Japan; not rare. Our four specimens from Tokyo and Wakanoura. It is one of the most strongly marked species. (*ruber*, red; *pes*, foot.)

8. SPHEROIDES XANTHOPTERUS (Schlegel).

Tetrodon xanthopterus Schlegel, Fauna Japonica, 1847, p. 284, pl. cxxv, fig. 1, Nagasaki.—Nystrom, Handl. Svensk. Vet. Akad., 1887, p. 48, Nagasaki.
Gastrophysus xanthopterus Bleeker, Act. Soc. Indo-Nederl., Japan, 1852, VI, p. 68.

Head $3\frac{2}{3}$ in length; depth $3\frac{1}{2}$; dorsal rays 16; anal rays 13.

Length of head less than distance between head and insertion of dorsal; interorbital space broad, $1\frac{2}{3}$ in head. Teeth bluntly pointed before, the cutting edge concave; groove between teeth prominent, the ridge on either side of groove low. Back prickly from nostrils to dorsal fin; abdomen with rather long, sharp prickles; sides and tail smooth. Lateral fold obscure. Dorsal and anal rather high and falcate. Caudal moderately lunate.

Color bluish; sides silvery, the back with cross shades or bands; 3 or 4 oblique streaks behind pectorals, besides some roundish blotches; sides of body and tail with 3 horizontal stripes, the upper fading into the color of the back, the stripes oblique at the anterior end. Base of dorsal and pectorals dusky; fins yellow. The dark markings behind the pectorals vary, even in the same fish.

Length 400 or 500 mm. Southern Japan; rare. A single stuffed specimen obtained by us at Nagasaki.

It is regarded by Dr. Günther as a variation of *S. rubripes*, but the coloration is markedly different and the fins are higher and more acute. (ξανθός, yellow; πτερόν, fin.)

9. SPHEROIDES PARDALIS (Schlegel).

Tetrodon pardalis Schlegel, Fauna Japonica, p. 282, pl. cxxi, fig. 2, Nagasaki. - Günther, Cat. Fish., VIII, 1870, p. 281, Nagasaki. - Nystrom, Handl. Svensk. Vet. Ak., 1887, p. 48, Nagasaki.—Jordan and Snyder, Proc. U. S. Nat. Mus., 1900, p. 360, Tokyo.

Head 3 in length; depth $3\frac{1}{2}$; depth of caudal peduncle $3\frac{1}{2}$ in head; eye $5\frac{1}{3}$; snout, $2\frac{2}{3}$; interorbital space $2\frac{1}{5}$; dorsal rays 10 or 11; anal rays 8 or 9.

Body rather robust; caudal peduncle conical, its length $1\frac{1}{2}$ in head; length of head somewhat less than distance between gill-opening and

insertion of dorsal. Eye 2 in snout; interorbital space concave. Nostrils separate, placed laterally in an oval elevation. Teeth bluntly pointed in front, the cutting edges slightly concave; suture without a deep groove, ridges on either side not prominent. Inner fold of gill-opening slightly exposed.

Lateral fold perceptible only posteriorly, where it is rather obscure. Lines of mucous pores like those of *S. rubripes;* skin soft, without prickles, almost entirely covered with small elevations resembling embedded scales. Fins low, about $2\frac{1}{6}$ in head, not falcate, the posterior edges convex. Caudal $1\frac{3}{5}$ in head, rounded posteriorly. Pectoral short, $2\frac{1}{2}$ in head.

Color brownish, rather dark; back and sides covered with round, blackish spots, somewhat smaller than the pupil; the interspaces not so wide as the spots; no large black spot above tip of pectoral or at base of dorsal. Fins dull orange; dorsal dusky; caudal blackish.

Coasts of Japan, rather common, reaching a length of about 380 mm. It varies somewhat in markings, but is easily distinguished from related species by the black spots. Our specimens are from Tokyo, Misaki, Matsushima, Onomichi, and Nagasaki. (πάρδαλις, leopard.)

10. SPHEROIDES ABBOTTI Jordan and Snyder, new species.

Head $2\frac{2}{5}$ in length; depth 4; depth of caudal peduncle 4 in head; eye 6; snout $2\frac{1}{6}$; interorbital space $2\frac{1}{2}$; dorsal rays 13; anal rays 12.

Body rather broad, robust, tapering posteriorly to the small, cylindrical, caudal peduncle, which is about equal in length to head; length

FIG. 3.—SPHEROIDES ABBOTTI.

of head considerably less than distance between gill-opening and insertion of dorsal; head nearly square in cross section; eye small, about half way between tip of snout and gill-opening; interorbital space broad, flat; distance between eyes about $3\frac{1}{2}$ times their diameter; jaws equal; teeth with scarcely perceptible ridges in front, the suture without a deep groove; not pointed anteriorly, the cutting edges almost

straight; inner flap at gill-opening equal in length to the outer, protruding a little; nostrils separate, in an oval elevation.

Lateral fold present. A line of mucous pores extending from a point behind the mouth backward, below, and close to the eye, passing in a broad curve above the pectoral, bending downward and running to the middle of base of caudal; a branch passing over nape just above gill-opening; another leaving the lateral line behind the eye, going downward and disappearing on the throat; a third, having its origin immediately behind the latter, going upward and forward, passing downward close behind the nostrils, and joining the lateral line; a branch crossing the snout above; a line extending along side of body, below lateral fold, from a point below tip of pectoral to base of caudal; no inclosed quadrangular space behind eye. Skin smooth.

Dorsal and anal fins pointed, the edges straight or slightly concave; of about equal height; 1¾ in head. Caudal 1⅜ in head, subtruncate, the upper lobe slightly pointed, the lower somewhat rounded. Pectoral 2¼ in head; of 13 rays.

Color light gray, abruptly white below; back covered with close-set black spots mostly smaller than the pupil and broader than the interspaces which form reticulations around them; numerous small spots below the eye; spots largest on upper part of tail, some of them confluent; spots on upper part and below base of dorsal mostly confluent, forming elongate blotches. Caudal dusky posteriorly; edged above and below with pale; other fins grayish.

Tokyo Bay. Known from one specimen about 325 mm. long. Type No. 6523, Leland Stanford Junior University Museum.

It is distinguished from *S. pardalis* by the smaller, closer set spots, the general gray coloration, and the more concave caudal. From *S. stictonotus* it differs in color, in having smooth skin, less falcate fins, and fewer dorsal and anal rays. (Named for James Francis Abbott, of Hachiman, Japan, formerly of Leland Stanford Junior University, in recognition of his studies of Japanese animals.)

11. SPHEROIDES EXASCURUS Jordan and Snyder, new species.

Head 3½ in length, depth 4⅛; depth of caudal peduncle 3½ in head; eye 4; snout 2⅖; interorbital space 2½; dorsal rays 12; anal rays 12.

Body moderately elongate, not broadened anteriorly; caudal peduncle not compressed, its length slightly less than that of head; length of head much less than distance between gill opening and insertion of dorsal. Eye large, 1½ in snout. Interorbital space concave; distance between eyes a little more than twice their diameter. Nostrils separate, in an oval elevation. Teeth bluntly pointed anteriorly, the cutting edges concave, the suture without a deep groove; ridges on either side of groove scarcely perceptible. Lower jaw projecting beyond the upper.

Skin smooth; a few small, deeply imbedded prickles on the breast and belly. Lines of mucous pores distinct; the lateral line extending from a point behind the mouth backward below and close to the eye, passing in a broad curve above the pectoral, bending downward and running to the middle of base of caudal; a branch passing over nape just above gill opening; another leaving the lateral line at a point close behind eye, going downward and disappearing on the throat; a third having its origin immediately before the latter, going upward and forward, passing downward close behind the nostrils and joining the lateral line; no inclosed quadrangular space behind eye; a branch crossing the snout above; a line originating near the angle of mouth, extending downward along the chin; curving backward along throat and bending upward to near base of pectoral; another beginning below and a little before the end of the latter, running backward, curving upward over anal, and extending to base of caudal.

Fins high, the dorsal pointed, its posterior edge straight, the longest

FIG. 4.—SPHEROIDES EXASCURUS.

rays 1½ in head; anal similar in shape, slightly higher than dorsal. Caudal subtruncate, somewhat rounded posteriorly. Pectoral about 2½ in head; of 14 rays.

Dark gray above, the color ending abruptly at the lateral fold; belly white; back blackish, with obscure grayish vermiculations; sides with very distinct, gray reticulations around irregular black spots, some of which are as large as pupil; sides of head very distinctly marked; a large black spot on base of pectoral; no distinct black blotch behind pectoral or below dorsal; dorsal with dark clouds; caudal with its rays distinctly spotted and reticulated like sides of body; gray area of sides extending below the dark spots.

Misaki; described from a fine specimen about 200 mm. long. Type No. 6524, Leland Stanford Junior University Museum. The species is related to *S. abbotti*, but differs from that and all others in its peculiar markings and especially in the extension of the spots and streaks on the caudal fin.

(ἐξασκέω, to adorn; οὐρά, tail.)

12. SPHEROIDES OCELLATUS (Osbeck).

Tetrodon ocellatus OSBECK, Iter Chinensis, 1757, p. 226; English ed. I, p. 364; II, p. 331, Canton.—LINNÆUS, Syst. Nat., 12th ed., p. 411, after Osbeck.—RICHARDSON, Voyage Sulphur, 1843, p. 120, pl. LVIII, figs. 1, 2; Canton, Japan.—GÜNTHER, Cat. Fish., VIII, 1870, p. 279, China.

Head 3; depth 3. D. about 14; A. 14. Body rather robust, covered with minute spines from near nostrils to dorsal fin; abdomen entirely covered with similar spines, sides naked; dorsal and anal low, slightly falcate; lateral ridge obscure; caudal truncate; upper teeth without ridge in front; olivaceous, sides silvery, young with round pale spots; a large black spot behind pectoral on each side, this connected with its fellow by a black cross band over the back; this band and the spots edged all around by white; a black, white-edged blotch at base of dorsal. Length about a foot. (Günther); (Richardson).

Coasts of China, mentioned by Richardson as from Japan, where it is probably rare; not seen by us. Common about Canton. (*Ocellatus*, ocellate.)

13. SPHEROIDES ALBOPLUMBEUS (Richardson).

NAGOYABUKU (NAGOYA PUFFER); KOMONBUKU (SMALL MARBLED PUFFER); SHIWOSAIBUKU (ESTUARY PUFFER).

Tetraodon alboplumbeus RICHARDSON, Voy. Sulphur, Ichth., 1844, p. 121, pl. LVIII, figs. 6, 7, Canton; Ichth. China, p. 199, Canton.—BLEEKER, Atlas Gymnodontes, p. 62, pl. I, fig. 1, Sumatra, Borneo, Java.

Gastrophysus alboplumbeus BLEEKER, Nat. Tydskr. Nederl. Ind., VII, p. 104.

Lagocephalus alboplumbeus JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 360, Tokyo.

Tetrodon oblongus var. *alboplumbeus* GÜNTHER, Cat. Fish., VIII., p. 278, Sumatra, China, Japan.—ISHIKAWA, Prel. Cat., 1897, p. 2, Izu, Riukiu, Kiusiu, Tokyo.

Tetrodon pœcilonotus SCHLEGEL, Fauna Jap., 1847, p. 279, pl. CXXVI, fig. 2, Nagasaki.

Tetrodon niveatus BREVOORT, Japan. Fish., 1856, p. 284, Shimoda.

? *Tetrodon hartlandi* BIANCONI, Mem. Accad. Bologna, VI, p. 146, pl. II, fig. 1, Mozambique.

? *Gastrophysus microphthalmus* BLYTH, Journ. As. Soc. Bengal, XXIX, 1867, p. 174, Sifang.

Head 3¼ in length, depth 3⅘; depth of caudal peduncle 3⅗ in head; eye 5⅔; snout 2½; interorbital space 3; dorsal rays 12; anal rays 11.

Body rather elongate, the dorsal contour little elevated; caudal peduncle not compressed, its length 1¼ in head; length of head much less than distance between gill opening and base of caudal. Eye 2⅓ in snout; interorbital space broad, flat. Nostrils in elevated, oblong, papillæ, the openings lateral. Teeth scarcely pointed before, the cutting edges somewhat concave; suture without groove; no vertical ridges on either side of suture. Inner flap at gill opening exposed; width of gill opening equal to base of pectoral.

Lateral fold prominent. Lines of mucous pores as described in *S. abbotti*, with the addition of one extending from chin backward and

upward to near base of pectoral. Skin of back and belly covered with prickles; the two areas confluent both before and behind pectorals.

Color very much as in *S. vermicularis;* grayish black above with numerous round, pale spots which are larger, more confluent, and more irregular on sides, none of them sharply defined or stellate, most of them broader than the interspaces; a dark blotch behind pectoral; another at base of dorsal; the dark blotches more apparent on young individuals; caudal dusky toward tip; other fins more or less dusky.

Coasts of Japan, especially southward, generally common. Our specimens are all small, none over 160 mm. in length. They are from Aomori, Tokyo, Wakanoura, Onomichi, and Tsuruga.

Except for the prickly back and sides, this species is scarcely different from *Spheroides vermicularis.* Our specimens represent *Tetraodon pœcilonotus* Schlegel, which seems to be identical with the Chinese species called *S. alboplumbeus. Spheroides oblongus* of the East Indies is different in color from any of these. *Tetrodon niveatus* from Shimoda with "many small blotches of bluish white" must be the present species rather than *S. niphobles*, which has small stellate spots of pure white.

(*Albus*, white; *plumbeus*, lead color.)

14. SPHEROIDES VERMICULARIS (Schlegel).

MABUKU (TRUE PUFFER). SHIWOSAIBUKU (ESTUARY PUFFER).

Stachelloser Aufblaser aus Nagasaki Krusenstern, Reise, Atlas, pl. li, fig. 1.
Tetrodon vermicularis Schlegel, Fauna Japonica, 1847, p. 278, pl. cxxiv, fig. 1. Nagasaki.—Günther, Cat. Fish., VIII, 1870, p. 280, after Schlegel.—Ishikawa, Prel. Cat., 1897, p. 2, Esashi, Tokyo, Boshu.
Gastrophysus vermicularis Bleeker, Verh. Bat. Gen., Japan, XXV, p. 125.

Head, $3\frac{1}{4}$ in length; depth $3\frac{1}{2}$; depth of caudal peduncle $3\frac{4}{5}$ in head; eye $5\frac{1}{2}$; snout $2\frac{2}{5}$; interorbital space $2\frac{2}{5}$; dorsal rays 12; anal rays 12.

Body somewhat elongate, the caudal peduncle not compressed, its length $1\frac{1}{3}$ in head; length of head considerably less than distance between gill opening and insertion of dorsal fin. Eye $2\frac{1}{2}$ in head; interorbital space flat. Nostrils in an oblong elevation, not tubular. Teeth scarcely pointed anteriorly, the cutting edges concave; no conspicuous depression along suture, and no vertical ridge on either side. Width of gill opening equal to that of base of pectoral, the inner flap exposed somewhat.

Lateral fold well developed. Lines of mucous pores not very distinct, arranged as in *S. abbotti.* Skin smooth.

Dorsal and anal $1\frac{5}{6}$ in head, pointed; the anal somewhat falcate. Caudal truncate $1\frac{2}{3}$ in head. Pectoral 2 in head, the upper angle rather acute, the lower rounded.

Color dark, with rounded or oblong irregular bluish white spots above, which are confluent along sides into larger, elongate spots and vermiculations which are smaller on head and middle of back; a large dark blotch behind pectoral; traces of a dusky spot below dorsal; caudal dusky posteriorly; other fins with a little dusky; the anal often without dark color. The ground color is sometimes gray; in other cases almost black. There are some variations in amount of pale markings.

Southern Japan, rather common. Known from the other entirely smooth species by the vaguely defined vermiculate pale spots, which are larger along the sides.

Here described from a specimen from Kobe; numerous others are from Tokyo, Misaki, Tsuruga, and Nagasaki. The species seems to reach a small size only, and none show any signs of prickles.

(*Vermicularis*, with worm tracks.)

15. SPHEROIDES BOREALIS Jordan and Snyder, new species.

Head $3\frac{1}{4}$ in length; depth $4\frac{1}{4}$; depth of caudal peduncle $4\frac{1}{2}$ in head; eye $5\frac{1}{2}$; snout $2\frac{1}{4}$; interorbital space $3\frac{2}{5}$, dorsal rays 13; anal rays 11.

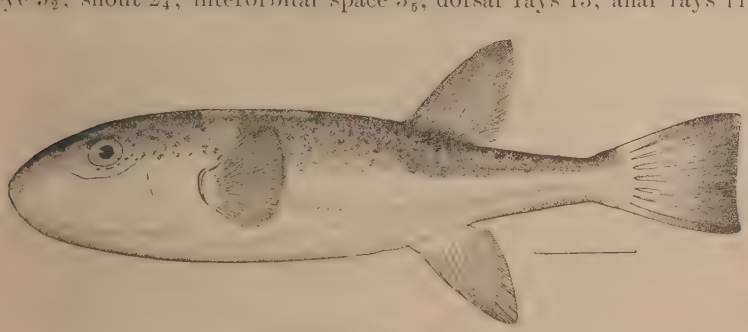


FIG. 5.—SPHEROIDES BOREALIS.

Body moderately elongate, the dorsal contour little elevated; the caudal peduncle narrow, not compressed, its length contained about $1\frac{1}{3}$ in head. Length of head much less than space between gill-opening and insertion of dorsal; interorbital space slightly convex. Eye $2\frac{2}{3}$ in snout. Nostrils located in an oval elevation. Jaws equal. Teeth not pointed anteriorly, the cutting edges straight; suture between teeth without deep groove, the vertical ridges on either side of suture evident though not prominent. Gill opening not quite so wide as base of pectoral, the inner flap exposed along its edge. Lateral fold present. Skin without prickles. Lines of mucous pores indistinct; lateral line running from snout backward below eye, curving upward over the pectoral, passing downward and backward to base of caudal fin; a branch passing over the nape above gill openings; a branch pass-

ing from behind eye, upward and forward, curving downward between nostril and eye, and joining the lateral line; another branch, having its origin posterior to the eye, coinciding with the latter, passing downward and disappearing on the throat; a branch passing over the snout just anterior to the nostrils; a line extending downward and backward from chin to a point near base of pectoral; another, having its origin below and a little anterior to the latter, running backward below lateral fold to base of caudal.

Dorsal and anal pointed, the latter slightly falcate, the height about $1\frac{3}{4}$ in head. Caudal truncate, its length $1\frac{1}{2}$ in head. Pectoral slightly rounded posteriorly, $2\frac{2}{3}$ in head, the number of rays 14.

Color dark brown above, with faint, rounded, pale spots, sometimes confluent in vermiculations, around darker spots, pale spots, those on back a little smaller than those on sides, none of the spots white and none sharply defined. A round jet-black spot, edged with pale above tip of pectoral, this well defined and larger than eye, not meeting its fellow across the back; a large black blotch on and below base of dorsal; dorsal and caudal largely dusky toward tip; pectoral and anal pale.

Here described from a specimen about 180 mm. long, from Mororan, Hokkaido. Type No. 6525, Leland Stanford Junior University Museum.

This species is very close to *Spheroides vermicularis*, but the body is stouter, the bony interorbital area narrower, and the spots are more distinctly rounded, when vermiculate surrounding darker spots of the ground color. It is extremely abundant in northern Japan. Our very many specimens, none more than 6 inches long, are from Otaru, Mororan, Hakodate, Aomori, Same-Minato, and Matsushima. (*Borealis*, northern.)

Measurements of Spheroides borealis.

	Mororan, Hokkaido.				Hakodate, Hokkaido.			
Length in millimeters	151	142	142	98	131	113	100	54
Depth expressed in hundredths of length	26⅛	25	26	27	26	26	25	28
Depth of caudal peduncle	7	7	7⅛	7	7⅛	8	7	8
Length of caudal peduncle	26	25	25⅛	24	25⅛	23⅛	25	24
Length of head	31	31	32	32	32⅛	31	32	35
Width of interorbital space	9	9⅛	9	9	9	8	7	6⅛
Length of snout	15	14	13	14	14	13⅛	13	15
Diameter of orbit	6	6	6	6⅛	7	6⅛	7	7⅛
Distance from snout to dorsal fin	65	64⅛	65	67	67	65⅛	66	69
Height of longest dorsal rays	18⅛	18⅛	16⅛	18	17	17	17	17⅛
Height of longest anal rays	20	18	17⅛	19	17	16⅛	18	17
Length of caudal fin	18	19	19	22	19	21	19	22
Number of rays in dorsal fin	13	13	13	14	13	13	13	13
Number of rays in anal fin	11	12	11	11	12	11	12	11

16. SPHEROIDES NIPHOBLES Jordan and Snyder, new species.

Head $3\frac{1}{6}$ in length; depth $3\frac{4}{5}$; depth of caudal peduncle $3\frac{2}{3}$ in head; eye 5; snout $2\frac{1}{2}$; interorbital space 3; dorsal rays 12; anal rays 10.

Body rather robust, almost as wide as deep; caudal peduncle conical, not compressed, its length $1\frac{2}{3}$ in head. Head much shorter than distance between gill opening and insertion of dorsal. Eye about $1\frac{1}{2}$ in snout; interorbital area flat, the space between eyes $2\frac{1}{2}$ times their diameter. Nostrils in low, oblong, elevations. Teeth obtusely pointed, the cutting edges concave; sutures between teeth without groove, the elevations on either side scarcely noticeable; width of gill-opening somewhat less than that of base of pectoral, the edge of inner flap exposed.

Small prickles on nape, anterior part of back, and on belly, the skin elsewhere smooth. Lateral fold rather prominent posteriorly. Lines of mucous pores rather distinct; arranged as in *S. borealis*.

Dorsal and anal fins rounded, their height 2 in head. Caudal convex posteriorly; its length $1\frac{1}{3}$ in head. Pectoral $2\frac{1}{3}$ in head, its posterior edge convex; number of rays, 14.

FIG. 6.—SPHEROIDES NIPHOBLES.

Color dark grayish, everywhere above covered with sharply defined white stellate spots; nearly all round, narrower than their interspaces, and not enlarged or confluent along sides; a distinct black blotch above pectoral, with white below it, but not surrounded by white; a black blotch below soft dorsal; caudal dusky at tip; fins otherwise pale.

Described from type No. 6526, Leland Stanford Junior University Museum; from Tokyo, Japan.

Our numerous specimens are from Tokyo, Misaki, Wakanoura, Tsuruga, and Nagasaki. On some of these the dark color on the side is bordered by a dusky shade. In a few the lateral spots are a little larger than those on the back. In all the space just below eye is without distinct spots.

This species is very close to *S. alboplumbeus*, but is smoother, and differs from all the others in the stellate character of the spots, which are distinctly white.

(*νιφοβλής*, snowed on, from the stellate spots.)

Measurements of Spheroides niphobles.

	Tokyo, Japan.				
Length in millimeters	119	120	100	98	98
Depth expressed in hundredths of length	28	28	26⅜	26	29
Depth of caudal peduncle	9	8⅜	8⅜	8	8⅛
Length of caudal peduncle	24	24⅛	25	24	22
Length of head	33	32	32	32	34
Width of interorbital space	10⅛	9	10	8⅜	10
Length of snout	14⅛	12⅜	14	14	16
Diameter of orbit	8	7	8	7	7
Distance from snout to dorsal fin	69	68	69	67	70
Height of longest dorsal rays	18	18	17½	18	18
Height of longest anal rays	19	17⅜	17	17½	20
Length of caudal fin	22	22	23⅜	21	24
Number of rays in dorsal fin	12	12	12	12	12
Number of rays in anal fin	10	10	10	10	10

17. SPHEROIDES RICHEI (Fréminville).

NAGOYABUKU.

Tetrodon richei Fréminville, Nouv. Bull. Philom., II, p. 250, pl. IV, fig. 2.—Bleeker, Atlas Ichth. Gymnodontes, p. 461, pl. IX, fig. 3, Derwent, Hobarttown, Tasmania.—Günther, Cat. Fish., VIII, 1870, p. 285, New Zealand, South Australia, Hobarttown.—Ishikawa, Prel. Cat., 1897, p. 2, Kagoshima.

Head 3¼; depth 3⅔; D. 9; A. 10.

Body from the lips, above, below, and on both sides, closely covered with small spines; caudal peduncle smooth; snout obtuse; interorbital space broad; orbit with a free fold for its whole circumference; no lateral fold on body or tail.

Color greenish, whitish below, with a few large irregular black spots or blotches above, some of these about as large as eye.

Coasts of Australia and New Zealand (Bleeker); a specimen from Kagoshima, referred to this species by Dr. Ishikawa, is in the Imperial Museum of Tokyo. This identification is by no means certain.

18. SPHEROIDES CHRYSOPS (Hilgendorf).

Tetrodon chrysops Hilgendorf, Sitzgber. Naturf. Freunde, May 20, 1879, p. 80, Tokyo, type No. 10625, Mus. Berl.

Head 2⅘ in length; depth 2½; depth of caudal peduncle 3 in head; eye 5⅓; snout 2⅔, interorbital space 2⅖; dorsal rays 10; anal rays 9.

Body very robust, the caudal peduncle somewhat compressed, its length about 1⅓ in head. Head large, its length equal to distance between gill opening and insertion of dorsal (not quite so long in one specimen). Interorbital space somewhat concave, occasionally flat or slightly convex. Eye moderate, 2 or 2½ in snout. Nostrils with tubes, the openings lateral. Teeth not pointed in front, the cutting edges straight or somewhat concave, the suture without a deep groove, no ridges bordering suture. Gill opening small, not extending above upper edge of base of fin, the inner or secondary flap slightly exposed.

Body naked, the skin covered with minute pits. Lines of mucous

pores similar to those of *S. abbotti*, except that the upper and lower branches just behind the eye are concurrent, and the line extending from the chin backward is very indistinct.

Dorsal and anal of equal height; $1\frac{3}{4}$ in head; rounded. Caudal $1\frac{1}{5}$; rounded posteriorly. Pectoral about 2 in head; its posterior edge convex.

Pinkish brown above or chocolate color, becoming gradually paler below; back with scattered, very irregular black spots and mottlings, all smaller than eye; no large black blotches behind pectoral or below dorsal; fins plain dusky; the caudal tipped with blackish in one specimen; iris yellow.

FIG. 7.—SPHEROIDES CHRYSOPS.

Coast of Japan, here described from four specimens, the largest about 300 mm. long, from Tokyo market and from Misaki.

It is a well marked species, allied to *S. pardalis*, but known at once by its color and its plump form.

(χρυσός, gold; ὤψ, eye.)

3. TETRAODON Linnæus.

Tetraodon LINNÆUS, Syst. Nat., 10th ed., 1758 (*lineatus*).

Les Orcides LACÉPÈDE, Hist. Nat. Poiss., I, 1797, p. 256 (*fascé;* French names only); based on front view of *Tetraodon stellatus*.

Ovum BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 530 (*commersoni*); after Lacépède; name preoccupied in mollusks.

Orcides DUMÉRIL, Zoologie Analytique, 1806; after Lacépède.

Oonidus RAFINESQUE, Analyse de la Nature, 1815, p. 90 (substitute for *Ovum*).

Arothron MÜLLER, Abh. Berl. Akad., 1839, p. 252 (*testudinarius=reticularis*).

Les Epipedorhynques (*Epipedorhynchus*) BIBRON, Rev. Zool., 1855, p. 279.

Les Dilobomyctères (*Dilobomycter*) BIBRON, Revue Zool., 1855, p. 279 (*reticularis*, etc).

Les Dichotomyctères (*Dichotomycter*) BIBRON, Rev. Zool., 1855, p. 279 (*fluviatilis;* no diagnosis).

Brachycephalus HOLLARD, Gymnodontes, 1867, p. 324.

Crayracion BLEEKER, Atlas Gymnod., p. 65, after Klein, 1742; type *spengleri*, erroneously supposed to belong to this group.

Body rather robust, the skin usually more or less prickly. Nostril on each side with a tentacle, bifid to the base, its tips without opening, the branches of the large olfactory nerve ending in cup-like depressions along the inner edges of the two flattish lobes. Dorsal and anal fins rounded, each of 7 to 14 rays; the dorsal more or less in front of anal; caudal rounded. Vertebræ usually $8+10=18$. A ring muscle about the eye forming eyelids. Species numerous, chiefly of the tropical Pacific; distinguished from *Spheroïdes* by the solid nasal tentacles. Most or all of our species belong to the section or genus *Ovoïdes*, distinguished by the form of the postfrontals and prefrontals, which are deflected to describe the segment of a circle. The value of this character should be tested before *Ovoïdes* is recognized as a distinct genus. (τέτρα, four; ὀδούς, tooth.)

a. TETRAODON: Dorsal and anal rather large, each of about 14 rays; body everywhere with round pale spots; belly paler than back ..... *firmamentum*, 19.

aa. OVOIDES: Dorsal and anal small, each of about 10 rays.

b. Spots on back black, darker than the ground color; spines on belly black; forehead broad, flattish; spines stiff ..... *aërostaticus*, 20.

bb. Spots on back whitish or pale, paler than the ground color; spines on belly whitish, rather flexible.

c. Belly crossed by black parallel stripes with white interspaces, the stripes fading with age; interorbital area concave; gill-opening black..... *hispidus*, 21.

cc. Belly covered with round white spots on a dark background, like the back; interorbital area narrow, flattish; prickles very close-set..... *meleagris*, 22.

19. TETRAODON FIRMAMENTUM (Schlegel).

HOSHIFUKUTO (STARRY PUFFER).

Tetrodon firmamentum SCHLEGEL, Fauna Japonica, p. 280, pl. CXXVI, fig. 2, 1847, Nagasaki.—BLEEKER, Verh. Bat. Gen., Japan, XXVI, p. 124.—GÜNTHER, Cat. Fish., VIII, 1870, p. 299, Nagasaki.

Body rather elongate; small two-rooted spines covering every part, except snout and posterior part of caudal peduncle. Snout $2\frac{2}{3}$ in head, a little less than width of interorbital space, which is rather convex. Dorsal and anal higher than in other species, each of about 14 rays, the front of anal nearly under middle of dorsal; caudal long, truncate.

Color grayish above, paler below; the entire body and base of the caudal covered with ovate white spots, smaller than the eye and narrower than the interspaces of the ground color. Length, a foot.

Nagasaki; known only from the original types; not seen by us.

(*Firmamentum*, the sky; from the starry spots.)

20. TETRAODON AEROSTATICUS (Jenyns).

Tetrodon lineatus BLOCH, Ausländ. Fische, I, 1785, p. 128, pl. CXLI (not of Linnæus), and of various authors.—SCHLEGEL, Fauna Japonica, 1847, p. 287, pl. CXXV, fig. 2, Nagasaki.

Arothron lineatus BLEEKER, Verh. Bat. Gen., Japan, p. 40.

Crayracion lineatus Bleeker, Atlas Gymnodontes, p. 70, pl. II, fig. 1; pl. VIII, fig. 1, Bali, Singapore, Celebes, Amboyna.

Tetrodon aerostaticus Jenyns, Voy. Beagle, p. 152, 1842, locality unknown.

Head, 2½ in length; depth of caudal peduncle, 3½ in head; eye, 7½; snout, 2¼; interorbital space, 2¾; dorsal rays, 10; anal rays, 10.

Body short, broad, and very deep, the belly greatly inflatable; caudal peduncle somewhat compressed, its length 3 in head. Eye small, 3½ in snout. Interorbital space broad, flat, the distance between eyes 4 times their diameter. Mouth small, its width about 2 times diameter of eye. Cutting edges of teeth concave, the suture without deep groove, and without ridges on either side. Nostrils with bifid tentacles; no apparent openings. Gill-opening almost as wide as base of pectoral.

Lips, bases of fins, and caudal peduncle naked, the other parts of body covered with prominent spines; those of the upper parts and sides sharp, those of belly club-shaped.

Fins all rounded, the membranes thin; dorsal and anal about 3 in head, caudal 2 in head. Pectoral rays 19.

Color very dark brown; everywhere above with round, jet-black spots of different sizes, but all smaller than eye; belly with broad, black bands, more or less confluent and irregular, those anteriorly forming black reticulations around pale spots; vent black; base of pectoral and anal with black spots, the caudal spotted, the other fins plain.

East Indies; occasionally north to Japan; here described from a fine specimen taken at Houmoku, near Misaki, by Capt. Alan Owston. A smaller specimen, also from Misaki, shows no black spots above and the bands below are narrower, widely separated, and parallel. In both the spines are black, both on the light and dark ground color.

Dr. Günther unites this, with several other of Bleeker's species, under the name of *Tetrodon stellatus*. The oldest name, however, certainly belonging to the present form is *aerostaticus*. *Tetrodon stellatus* is figured as having the rather high dorsal, like the caudal, well spotted with black. It is, however, possible that *Tetraodon stellatus* is the adult of the same fish.

(*Aerostaticus*, resting in air as a balloon.)

21. TETRAODON HISPIDUS Linnæus.

? *Tetraodon hispidus* Linnæus, Syst. Nat., 10th ed., 1758, p. 333, China, after Lagerstrom (probably this species, the spots not indicated in Lagerstrom's figure); Syst. Nat., 12th ed., 1766, p. 411.—? Bloch, Ausl. Fische, I, about 1786, p. 130, pl. CXLII, Coromandel.

Tetrodon hispidus Günther, Cat. Fish., VIII, 1870, p. 297, Red Sea, Zanzibar, Ceylon, Mozambique, Port Natal.

Tetrodon perspiciliaris Rüppell, Atlas Fische, p. 63, Red Sea.

Tetrodon implutus Jenyns, Voyage Beagle, Fish., 1842, p. 152, Vanikoro.

Crayracion implutus Bleeker, Atlas Gymnodontes, p. 71, pl. I, fig. 5, Sumatra, Cocos, Solor, Timor, Batjan, Amboyna, Banda.

Tetraodon laterna RICHARDSON, Voy. Sulphur, 1842, p. 124, pl. LXI, fig. 2, Canton, after an incorrect drawing by John Reeves.—RICHARDSON, Ichth. China, p. 199, Canton.

Arothron laterna BLEEKER, Enum. Pisc. Archip. Ind., p. 200.

Tetrodon hispidus (*senistriatus*) GÜNTHER, Cat. Fish., VIII, 1870, p. 297, Amboyna, Aneitum, Australia.

Head, $2\frac{3}{5}$ in length; depth of caudal peduncle, 3 in head; eye, 6; snout, $2\frac{1}{4}$; interorbital space, 3; dorsal rays, 10; anal rays, 10.

Body robust, the belly enormously distensible, caudal peduncle compressed; the length $2\frac{1}{2}$ in head. Length of head less than distance between gill opening and insertion of dorsal. Interorbital space flat or somewhat concave, the distance between eyes $3\frac{1}{2}$ times their diameter. Cutting edges of teeth concave; suture without a deep depression, on vertical ridges along its side. Gill opening not quite so wide as base of pectoral. Nostrils with bifid tentacles, without apparent openings.

Lips, upper part of snout, bases of fins, and caudal peduncle naked; other parts covered with prickles or short, slender spines; those of the upper parts very short and pointed; of the lower parts longer, pointed, and with a minute, fleshy bulb near the tip. Lines of mucous pores very indistinct; a line (encircling the eye) passing in a broad curve above pectoral, then bending downward and extending to base of caudal fin.

Fins small, their edges rounded; dorsal and anal, $3\frac{1}{2}$ in head; caudal, $1\frac{2}{3}$; pectoral, 3.

Color blackish gray, the upper parts with oblong or rounded pale spots about as large as pupil; interspaces wider than spots; a large black blotch surrounded by a white ring around base of pectoral and gill opening; chin dusky; belly whitish, with parallel stripes of black, which fade and grow narrower on the median part; caudal with small white spots; other fins pale or with a little dusky.

Smaller specimens have the pale spots above much more obscure, while the black stripes on the belly are very distinct. The upper stripes are most distinct and are deeper in color at intervals, leaving a trace of about 4 dark cross bars on the side.

In adult specimens, apparently of the same species, collected in Honolulu by Dr. O. P. Jenkins, the stripes on the belly are obsolete. In the young from the same locality they are very distinct.

East Indies, north to the Riukiu Islands. Here described from a specimen, $5\frac{1}{2}$ inches long, from Okinawa (Coll. Y. Koneyama), and from two others, each of which is about 4 inches long, from Ishigaki Islands (Yaeyama; Coll. Capt. Alan Owston). The larger specimen is evidently identical with Bleeker's *implutus* and Richardson's *laterna*. The synonymy of Rüppell we have taken from Dr. Günther. The unidentified description of *Tetrodon hispidus* seems to belong to this species. The type came from China and was marked by vague, dark cross bands, but no pale spots are figured.

22. TETRAODON MELEAGRIS Lacépède.

Tetrodon meleagris LACÉPÈDE, Hist. Nat. Poiss., I, 1799, pp. 476, 505; seas of Asia, on a drawing by Commerson.—RICHARDSON, Voyage Sulphur, Fish, p 122, pl. XLVII, 57, figs. 1–3, locality unknown, probably China Seas; also notes a drawing from Tahiti by Solander.—GÜNTHER, Cat. Fish., VIII, 1870, p. 299, Richardson's type.

? *Arothron ophryas* COPE, Fishes Lesser Antilles, 1870, p. 479, Navigator Islands.

? *Ovoides ophryas* FOWLER, Proc. Ac. Nat. Sci. Phila., 1900, p. 528, pl. xx, fig. 2, after Cope's type.

? *Ovoides latifrons* JENKINS, Bull. U. S. Fish Comm., 1899 (June 8, 1901), p. 398. Honolulu.

Head, $2\frac{1}{2}$ in length; depth of caudal peduncle, $3\frac{1}{3}$ in head; eye, 8; snout, $2\frac{2}{5}$; interorbital space, $2\frac{1}{2}$; dorsal rays, 10; anal rays, 10.

Body robust, the belly capable of great inflation; dorsal contour evenly rounded, not much elevated; contour of snout slightly concave.

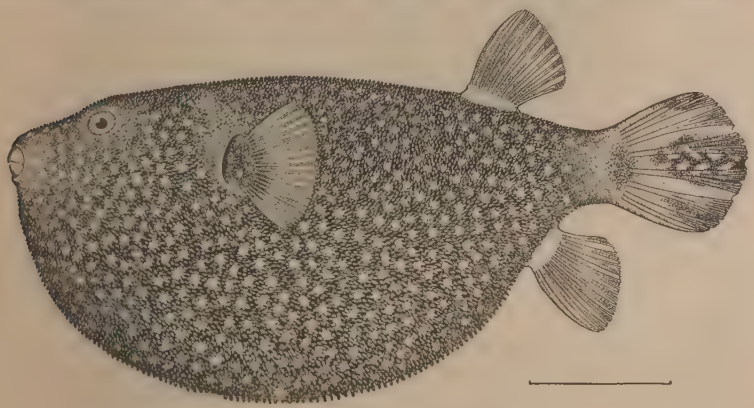


FIG 8.—TETRAODON MELEAGRIS.

Head large, its length less than distance between gill opening and insertion of dorsal fin; interorbital space somewhat convex. Eye small, the diameter about 3 in snout; a little nearer to tip of snout than to gill opening. Dental plates of about equal width, the suture without a deep groove, and without vertical ridges on either side. Gill opening not so wide as base of dorsal. Nostril with a bifid tentacle with 2 compressed flaps; no apparent opening.

Lines of mucous pores not evident except above eyes. Body everywhere except lips, border of gill openings, and bases of fins hispid with rather slender, thick-set spines; those of the back short and rather rigidly set; those below nearly twice as long and more easily depressed; the transition from shorter to longer spines gradual on the sides.

Fins with rounded edges; dorsal and anal of equal height, $2\frac{3}{5}$ in head; caudal, $1\frac{2}{3}$; pectoral, 2.

Color dark brown or blackish, the spines whitish; everywhere

covered with small, round, stellate, whitish spots, rather regularly placed, all narrower than pupil, and narrower than the interspaces. All the spots are round and those on sides of head, throat, and belly are largest. No bands on belly; base of pectoral black, with white spots; dorsal and anal dusky. Caudal spotted like the body.

Pacific Ocean.

One specimen from Okinawa, 125 mm. long, collected by Yonekichi Komeyama.

We identify this species with some doubt with *Tetraodon meleagris* as described, and as figured by Richardson. The only notable difference lies in the form of the pale spots, which are lenticular or oblong in *T. meleagris* and round in our specimen, as also in the specimens called *ophryas* and *latifrons*.

(*Meleagris*, a Guinea hen.)

Family III. TROPIDICHTHYIDÆ.

SHARP-NOSED PUFFERS.

This family includes small puffers, similar in external appearance to the Tetraodontidæ, but with the snout sharp and the back more or less compressed or ridge-like. The skeletal characters by which the group is defined are thus given by Dr. Gill: Medifrontals separated from the supraoccipital by the intervention of the sphenotics which are connected together and laterally expanded, but short; the prosethmoid prominent above, enlarged and narrowed forward. Vertebræ about 8 + 10. Head compressed, with a projecting, attenuated snout; dorsal and anal short, few-rayed. Nostrils wanting or little developed. Tropical seas; small species; none of them reaching a length of more than 6 inches.

a. Nostrils small, consisting of a raised rim with a small perforation ..... *Eumycterias*[1] 4.

4. EUMYCTERIAS Jenkins.

Eumycterias Jenkins, Bull. U. S. Fish Comm., 1899 (June 8, 1901), p. 399 (*bitæniatus*).

This genus differs from *Tropidichthys* in the less complete atrophy of the nostrils. These are reduced each to a raised rim or small papilla with a small perforation like a pin-prick.

(*εὖ*, well; *μυκτήρ*, nostril.)

[1] The nostrils are entirely wanting in *Tropidichthys*, the other genus of this family. The following is the synonymy of *Tropidichthys:*

Canthigaster Swainson, Nat. Hist. Fishes, II, 1839, p. 194 (diagnosis only; no species mentioned).

Psilonotus Swainson, Nat. Hist. Fishes, II, 1839, p. 328 (*rostratus*); substitute for *Canthigaster;* not *Psilonotus*, a genus of Hymenoptera of prior date.

Prilonotus (Kaup MS.) Richardson, Voyage Herald, 1854, p. 162 (*rostratus;* misprint).

Tropidichthys Bleeker, Nat. Tyds. Nederl. Ind., IV, 1854 (*valentini*).

Anosmius Peters, Wiegmann's Arch. 1855, p. 274 (*tæniatus*).

Rhynchotus (Bibron) Hollard, Études Gymnodontes, 1857, p. 320 (*peroni*).

23. EUMYCTERIAS RIVULATUS (Schlegel).

KITAMAKURA (SLEEPER WITH HEAD TO NORTH); YOKOBUKU (CROSSWISE PUFFER); AKAMEBUKU (RED-EYED PUFFER).

Tetrodon rivulatus SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 285, pl. CXXIV, fig. 3, Nagasaki.—GÜNTHER, Cat. Fish., VIII, 1870, p. 305 (copied).—ISHIKAWA, Prel. Cat., 1897, p. 2, Sagami, Tokyo.

Tetrodon grammatocephalus SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 286, pl. CXXVI, fig. 3, Nagasaki (young with obscure coloration).

? Eumycterias bitæniatus JENKINS, Bull. U. S. Fish Comm., 1899 (June 8, 1901), p. 400. Honolulu.

Head $2\frac{2}{3}$ in length; depth $2\frac{2}{5}$; depth of caudal peduncle $2\frac{1}{2}$ in head; eye $4\frac{1}{4}$; snout $1\frac{3}{5}$; interorbital space $3\frac{2}{5}$; dorsal rays 10; anal rays 10.

Body robust, deep, compressed, the dorsal contour greatly elevated, the outline from snout to occiput straight, the ventral contour evenly rounded; caudal peduncle deep, compressed, its length $1\frac{4}{5}$ in head. Head triangular in outline, its length equal to distance between gill-opening and dorsal fin; interorbital area narrow, nearly flat. Eye oblong, $2\frac{1}{2}$ in snout. Snout long, pointed. Nostrils with a single tube in a small, round papilla. Teeth scarcely pointed anteriorly, the cutting edges straight, the suture without a deep groove; no vertical ridge on either side of groove. Width of gill-opening equal to one-half base of pectoral.

A median elevation or fold of the skin extending from chin to anal opening. Skin smooth or with embedded prickles on adult specimens (100 to 150 mm. long). Young individuals with prickles above and below. With increasing age the prickles sink into the thick skin and entirely disappear. In dried specimens they are present, having 3 roots.

Color, olivaceous above, bright violet below. Adults marked above with numerous narrow bright blue lines running in various directions on the nape and back, mostly longitudinal on front of snout, and on back of tail, and descending vertically or obliquely about the eye; besides these lines are numerous vermiculations, especially on body and tail, while the belly and sides are sprinkled with orange dots. These are especially numerous above and behind the chin and about the gill opening. Belly with blue spots. All these markings are variable and some of them fade in spirits. Dorsal blackish at base, otherwise pale; caudal dusky bluish, its base dusky above and below. Specimens of about 150 mm. are marked as above. Those of about 100 mm. have in addition a dark curved line before gill opening, the upper part of which extends backward toward caudal. Smaller ones show in addition two blackish lateral stripes, the one extending from the eye nearly to the caudal, the other from the tip of snout, below pectoral; dark streaks before and behind gill-opening. Still smaller ones lack streaks and spots and have two black lateral bands, with a silvery interspace.

Some specimens of 100 mm. (Nagasaki), corresponding to *grammatocephalus*, lack streaks except about the eye, have no spots, the belly plain whitish, and the dark lateral streaks vaguely defined, the body mottled or blotched with paler.

Comparison of very many specimens from Tokyo, Misaki, Wakanoura, Kobe, and from Nagasaki leaves no doubt that all belong to a single species which varies much with age, as well as with the surrounding conditions. Additional variations arise in alcohol, which causes the fading of the violet and golden markings.

Southern Japan, common in shallow bays about rocks from Tokyo to Nagasaki. The description of *Eumycterias bitæniatus* from Honolulu applies very well to a young specimen of this species.

(*Rivulatus*, having streaks like streams.)

Family IV. DIODONTIDÆ.

PORCUPINE FISHES.

Body short, broad, depressed above. Belly moderately inflatable; body covered everywhere except on the lips and caudal peduncle with spines, which are usually 2-rooted or 3-rooted at their bony base. Caudal peduncle short and slender. Mouth moderate, terminal, each jaw covered with a bony plate like the beak of a bird; these not divided by a median suture. Nostrils on each side forming a small tentacle, usually with 2 openings. Eye rather large, gill opening moderate, immediately in front of the pectoral, which is short, broad, and rounded. Dorsal and anal fins short, similar to each other, rounded in form and placed posteriorly. Sluggish fishes, living on the bottom among weeds and corals, in tropical seas. When disturbed, they swallow air and float belly upward on the water. Their capacity of inflation is very much less than that of the *Tetraodontidæ*, from which family they differ chiefly in the stronger armature and in having no division in the bony plate of either jaw. They are rarely used as food, being generally regarded as poisonous. The species are mostly well known in collections, the singular form having attracted the attention of travelers in the earliest times.

a. Dermal ossifications mostly 2-rooted; the spines rather slender, but stiff and erectile. Nasal tentacle simple, with 2 lateral openings..... *Diodon*, 5.

aa. Dermal ossifications all or nearly all 3-rooted, each with a short, stiff, immovable spine. Nasal tentacle simple, with 2 openings..... *Chilomycterus*, 6.

5. DIODON Linnæus.

Diodon Linnæus, Syst. Nat., 10th ed., 1758, p. 335 (*hystrix*).

Paradiodon Bleeker, Atlas Ichth., Gymnodontes, 1867, p. 56 (*hystrix*); name a substitute for *Diodon*, transferred to another genus; the first species mentioned by Linnæus being *Diodon atinga*, which was therefore taken by Bleeker as the type.

Body robust, the belly moderately inflatable. Dermal spines strong, stiff, most of them 2-rooted and erectile, a few 3-rooted and therefore

immovable; both jaws entire; nasal tube simple, with 2 lateral openings. Pectorals broad, their margin undulate, the upper lobe longest; vertical fins rounded, the dorsal and anal short, posteriorly inserted, similar to each other. Tropical seas; the few species very widely distributed.

(*δίς*, two; *ὀδούς*, tooth.)

24. DIODON HOLACANTHUS Linnæus.

HARISUMBON (THOUSAND-NEEDLES); *YATSUMEBUKU* (EIGHT-EYED PUFFER); *HARIFUKU* (NEEDLE PUFFER).

Ostracion oblongus holacanthus Artedi, Genera 60, No. 20, 1738, India.
Diodon holacanthus Linnæus, Syst. Nat., 10th ed., 1738, p. 335, after Artedi.
Diodon holacanthus Jordan and Evermann, Fish. N. M. America, 1898, p. 1746, Florida Keys, La Paz.
Diodon liturosus Shaw, Gen'l Zool., 1806, V, p. 436, pl. II, New Cytherea after *le diodon tacheté* of Lacépède.
Diodon spinosissimus Cuvier, Mém. Mus., IV, 1818, p. 134; no locality.
Diodon novemmaculatus Cuvier, Mém. Mus., IV, 1818, p. 134; no locality.—Schlegel, Fauna Japonica, 1847, p. 289, pl. cxxviii, fig. 2, Nagasaki.
Diodon sexmaculatus Cuvier, Mém. Mus., IV, 1818, p. 134, no locality.
Diodon multimaculatus Cuvier, Mém. Mus., IV, 1818, p. 134, no locality.
Diodon quadrimaculatus Cuvier, Mém. Mus., IV, 1818, p. 134, Otaiti.
Paradiodon quadrimaculatus Bleeker, Atlas, Gymnodontes, 1867, p. 58, pl. viii, fig. 2, Solor, Amboyna.
Diodon melanopsis Kaup, Wiegmann's Archiv., 1855, p. 228.
Diodon maculatus Günther, Cat. Fish., VIII, 1870, p. 307, St. Croix, Jamaica, Hawaii, China, Sulu Sea, Indian Ocean.—Ishikawa, Prel. Cat., 1897, p. 1, Tokyo, Miyako-Shima, Riukiu.

Eyes well behind line of angle of mouth. Frontal spines long, usually longer than post-pectoral spines, about twice as long as eye in adult; predorsal spines not shortened, 2-rooted, erectile; 14 to 17 spines in a series between snout and dorsal; post-pectoral spines not especially elongate, their development variable; dorsal rays usually 12; anal 12; pectoral broader than long, its upper lobe pointed, lower lobe rounded. Body marked with black spots and blotches irregular in size, usually a broad black bar from eye to eye, continued below eye as a narrow bar; a broad bar across occiput; a black blotch above each pectoral; a short bar in front of dorsal; another in which the dorsal is inserted; a blotch behind pectoral, and many small spots and blotches on upper parts; fins with few spots, usually unmarked in the young. Young (Misaki) with the belly spotted; adult with the belly white, or with few spots.

In all warm seas. Our Japanese specimens agree entirely with the description given by Jordan and Evermann, printed above. This species may be simply the young of the larger, equally cosmopolitan species, *Diodon hystrix*. In this form the frontal spines are smaller than those behind the pectorals. We have six specimens from Wakanoura and two from Misaki.

6. CHILOMYCTERUS Bibron.

BURR-FISHES.

Chilomycterus Bibron, in Barneville, Revue Zoölogique, 1846, p. 40, (*reticulatus* = *tigrinus*).

Chilomycterus Kaup, Wiegm. Archiv., 1847, p. 365 (*antennatus*).

Cyclichthys Kaup, Wiegm. Archiv., 1855, p. 231 (*orbicularis*).

Cyanichthys Kaup, Wiegm. Archiv., 1855, p. 231 (*cæruleus*).

Diodon Bleeker, Atlas Ichth., Gymnod., 1865, p. 55 (*atinga*), the first species named by Linnæus; not *Diodon*, as properly restricted by Kaup to *Diodon hystrix*.

Body broad, depressed, moderately inflatable. Dermal spines short, stout, immovable, triangular, each with 3 roots; nasal tube simple, with two lateral openings; the tube sometimes rounded, sometimes flattened, and with the partition feeble and easily torn so that the tentacle appears undivided; caudal peduncle short; fins small, formed as in *Diodon*; jaws without median suture. Species numerous, of smaller size than those of *Diodon*, the spines broader and lower, their bases forming a coat of mail.

(χεῖλος, lip; μυκτήρ, nose "Narines non closes au sommet, mais chacune ayant l'apparence de deux lèvres, ou formée de deux tentacules réunis à la base.")

a. Chilomycterus: Nasal tentacle flattened, divided; fins spotted with black; supraorbital spines 3, feeble; no spine on forehead; supraocular cirrus wanting; upper parts with short, dark streaks or bars, becoming blotches on the sides.

californiensis.

25. CHILOMYCTERUS CALIFORNIENSIS Eigenmann.

TORABUKU (TIGER PUFFER); HISHIBUKU (DIAMOND PUFFER); KAERUBUKU (FROG PUFFER).

Diodon tigrinus Schlegel, Fauna Japonica, Poiss., 1847, p. 228, pl. CXXVIII, fig. 1, Nagasaki, not of Cuvier.

Chilomycterus tigrinus Ishikawa, Prel. Cat., 1897, p. 1, Tokyo, Misaki.

Chilomycterus californiensis[1] Eigenmann, Amer. Nat., V, 1891, pp. 25, 1133, San Pedro, California.

Chilomycterus californiensis Jordan and Snyder, Proc. U. S. Nat. Mus., 1900, p. 361, Tokyo.

Chilomycterus californiensis Snodgrass and Heller, Proc. Biol. Soc. Wash., 1901, Galapagos Islands.

[1]The following is the substance of Dr. Eigenmann's account: No tentacles anywhere. Spines of back all low, those of front especially so, increasing in size toward belly, where they become much larger than those of back. No spine on middle of forehead. A spine at upper anterior angle of orbit; one above, somewhat behind its middle; one slightly behind and above its upper posterior angle; another halfway between the last and the upper angle of pectoral, and another before and a little above the upper margin of pectoral. Blue above, white below; forehead and bases of all the fins with small (one-sixteenth inch) dark spots, fewer on anal; back densely covered with short streaks or bars, which become larger spots on sides; a few round dark spots (one-fourth inch in diameter) on belly; spots below eye larger than those on forehead, similar in size to those on caudal peduncle. Length 9⅞ inches. San Pedro, California.

Head $2\frac{3}{5}$ in length; depth $3\frac{2}{5}$; depth of caudal peduncle $5\frac{1}{2}$ in head; eye (width of bony orbit) $3\frac{2}{3}$; snout 3; interorbital space $1\frac{5}{6}$; dorsal rays 12; anal rays 11.

Upper contour of snout somewhat concave; interorbital space broad; concave; eyes placed obliquely, the anterior part of margins being nearer together than the posterior parts. Nasal tentacle flattened, bilobed. Gill opening somewhat wider than base of pectoral. No supraocular cirrus. Dental plates with a rough surface, without median suture, bluntly pointed anteriorly, the cutting edges concave.

Spines all short and blunt, increasing in size posteriorly both above and below; a very low, four-rooted spine on posterior part of interorbital space; three low supraocular spines, followed by a row of three somewhat higher spines, the posterior of which is above the pectoral fin; no spines on cheeks; middle of belly with very low spines; two small spines on upper part of caudal peduncle.

Fins rounded; dorsal $2\frac{1}{2}$ in head, anal $2\frac{1}{2}$, caudal $1\frac{3}{4}$, pectoral $2\frac{1}{4}$.

Color brown above, yellowish white below, the color distributed in indistinct clouds on back; five more or less distinct broad vertical bands on sides, the first extending downward from front of orbit and across chin below, the second immediately anterior to gill opening, the third posterior to base of pectoral, the fourth just anterior to insertion of dorsal, the fifth at base of caudal fin; upper lip dark; fins with many round brown spots.

Coasts of Japan, rare; also recorded from San Pedro, California, and the Galapagos; here described from a specimen from Tokyo. This specimen we can not separate from a Galapagos example which we identify as *Chilomycterus californiensis* Eigenmann, obtained at the Galapagos Islands by Snodgrass and Heller. It is close to *Chilomycterus atinga* (Linnæus) (= *reticulatus*) of the Atlantic. Comparison of specimens shows considerable variation, but no unquestionable differences among the Pacific examples.

Family V. MOLIDÆ.

HEAD-FISHES.

Body oblong or more or less short and deep, compressed, truncate behind, so that there is no caudal peduncle. Skin rough, naked, spinous, or tessellated. Mouth very small, terminal; teeth completely united in each jaw, forming a bony beak without median suture, as in the *Diodontidæ*. Dorsal and anal fins similar to each other, falcate in front, the posterior parts more or less perfectly confluent with the caudal around the tail; no spinous dorsal; no ventral fins; pelvic bone undeveloped; pectorals present. Belly not inflatable; gill openings small, in front of pectorals; an accessory opercular gill; no air bladder. Fishes of the open seas, apparently composed of a huge head to which small fins are attached; found in most warm seas, pelagic in habit,

and reaching a very large size. The very young are variously shortened in form and armed with spines. The flesh in these fishes is coarse and tough, and they are not used as food.

a. Body suborbicular, not twice as long as deep; skin thick, rough, gristly, without hexagonal plates ..... *Mola*, 7.

aa. Body oblong, about twice as long as deep; skin smooth, tessellated, with smooth hexagonal plates ..... *Ranzania*, 8.

7. MOLA Cuvier.

Mola CUVIER, Tableau Elém. Hist. Nat. Animaux, 1798, p. 323 (*rotunda* = *mola*).

Orthragoriscus BLOCH, Syst. Ichth., Schneider ed., 1801, p. 510 (*mola*); misprint for *Orthagoriscus*.

Cephalus SHAW, General Zoology, V, 1804, pp. 2, 432 (*mola*).

Orthragus RAFINESQUE, Caratt. Alc. Nuov. Gen. e Nuov. Sp. Anim. e Piante della Sicilia, 1810, p. 17 (*luna* = *mola*).

Diplanchias RAFINESQUE, Caratt. Alc. Nuov. Gen. e Nuov. Sp. Anim. e Piante della Sicilia, 1810, p. 17 (*nasus* = *mola*).

Tympanomium RANZANI, Novi Comm. Ac. Sci. Bonon., V, 1837, p. 3, pl. after p. 81 (*planci* = *mola*).

Trematopsis RANZANI, Novi Comm. Ac. Sci. Bonon., V, 1837, p. 3, pl. after p. 81 (*willughbeii* = *mola*).

Ozodura RANZANI, Novi Comm. Ac. Sci. Bonon., V, 1837, p. 3, pl. after p. 81 (*orsini* = *mola*).

Pedalion (Guilding MS.) SWAINSON, Nat. Hist. and Class'n. Fishes, etc., 1839, I, p. 199; II, pp. 195, 329.

Aledon CASTELNAU, Mém. sur Poissons Afrique Aust., 1861, p. 76 (*storeri* = *mola*).

LARVAL FORMS.

Molacanthus SWAINSON, Nat. Hist. and Class'n Fishes, etc., II, 1839, pp. 195, 329 (*pallasi*).

Pallasia NARDO, Ann. Sci. Regno Lombard., Venet., V, 1840, pp. 10, 112, (*pallasi*).

Acanthosoma DE KAY, New York Fauna, Fishes, 1842, p. 330 (*carinatum*).

Centaurus KAUP, Archiv. Naturgesch., I, 1855, p. 221 (*boops*).

Body ovate, strongly compressed, covered with a thick, rough, leathery, elastic skin, which is without bony plates. Profile forming a projecting fleshy nose above the mouth. Dorsal fin beginning not far behind pectorals, short and high, falcate, confluent with the anal around the tail; no large spines on the body. Clumsy fishes, found in most warm seas, reaching a great size; the young (*Molacanthus*) with the body deeper, much compressed, without trace of caudal fin, its place taken by a row of marginal spines.

(*Mola*, a millstone.)

26. MOLA MOLA (Linnæus).

Tetrodon mola LINNÆUS, Syst. Nat., 10th ed., 1758, pp. 334, 412, Mediterranean; after *Ostracion catheoplateus subrotundus* ARTEDI, Genera, 1738, p. 61.

Orthagoriscus mola BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 510.—SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 288, pl. CXXVII, Nagasaki.—GÜNTHER, Cat. Fish., VIII, 1870, p. 317.

Mola aculeata KÖLREUTER, Nov. Comm. Petropol., X, 1766, p. 337, pl. VIII, figs. 2 and 3.

Mola rotunda Cuvier, Tableau Elém. Nat. Hist., 1798, p. 323; after *Tetrodon mola* Linnæus.

Tetrodon lune Lacépède, Hist. Nat. Poiss., I, 1798, p. 509.

Orthagoriscus hispidus Bloch and Schneider, Syst. Ichth., 1801, p. 511.

Orthagoriscus fasciatus Bloch and Schneider, Syst. Ichth., 1801, p. 511.

Cephalus brevis Shaw, Gen. Zool., V, 1804, p. 437, pl. clxxvi.

Cephalus pallasianus Shaw, Gen. Zool., V, 1804, p. 440.

Diodon carinatus Mitchill, Ann. Lyc. Nat. Hist. New York, II, 1815, p. 264, pl. v, fig. 1, New York.

Acanthosoma carinatum De Kay, New York Fauna, Fishes, 1842, p. 330, pl. lv, fig. 179.

Orthagoriscus spinosus Cuvier, Règne Animal, 1817.

Cephalus orthagoriscus Risso, Eur. Mérid., III, 1826, p. 173.

Ozodura orsini Ranzani, Nov. Comm. Ac. Sci. Inst. Bonon., III, 1839, p. 82, Mediterranean Sea; Nov. Comm. Ac. Sci. Inst. Bonon., III, 1839, pl. vi.

Tympanomium planci Ranzani, Nov. Comm. Ac. Sci. Inst. Bonon., III, 1839, p. 82, Adriatic Sea.

Diplanchias nasus Ranzani, Nov. Comm. Ac. Sci. Inst. Bonon., III, p. 82, "in marei siculo."

Trematopsis willughbei Ranzani, Nov. Comm. Ac. Sci. Inst. Bonon., III, p. 82, in oceano.

Orthagoriscus retzii Ranzani, Nov. Comm. Ac. Sci. Inst. Bonon., III, p. 82, no locality.

Orthagoriscus ghini Ranzani, Nov. Comm. Ac. Sci. Inst. Bonon., III, p. 82, Mediterranean Sea.

Orthagoriscus rondeletii Ranzani, Nov. Comm. Ac. Sci. Inst. Bonon., III, p. 82, Mediterranean Sea.

Orthagoriscus blochii Ranzani, Nov. Comm. Ac. Sci. Inst. Bonon., III, p. 82, "in mari oceano."

Orthagoriscus alexandrini Ranzani, Nov. Comm. Ac. Sci. Inst. Bonon., III, p. 82, Adriatic Sea.

Orthagoriscus redi Ranzani, Nov. Comm. Ac. Inst. Bonon., III, p. 82, Mediterranean Sea.

Orthagoriscus oculeatus Ranzani, Nov. Comm. Ac. Inst. Bonon., III, p. 82.

Orthagoriscus lunaris Gronow, Cat. Fishes, ed. Gray, 1854, p. 165, Mediterranean Sea.

Orthagoriscus solaris Gronow, Cat. Fishes, ed. Gray, 1854, p. 165, Mediterranean Sea.

Orthagoriscus elegans Ranzani, Nov. Comm. Ac. Inst. Bonon., III, Atlantic Ocean.

Orthagoriscus battarae Ranzani, Nov. Comm. Ac. Inst. Bonon., III, Adriatic Sea.

Aledon storeri Castelnau, Poiss. Afr. Austr., pp. 75, 76.

Alédon capensis Castelnau, Poiss. Afr. Austr., pp. 75, 76, Cape of Good Hope.

Pallasia pallasi Nardo, Ann. Sci. Regno Lombard., Venet., X, 1840, p. 112, Venice.

Orthagoriscus analis Ayres, Proc. Cal. Ac. Sci., II, 1854, p. 31, fig. liv, San Francisco.

Mola nasus Steenstrup and Lütken, Overs. Dansk. Vid. Selsk. Forh., 1863, p. 36.

Mola retzii Steenstrup and Lütken, Overs. Dansk. Vid. Selsk. Forh., 1863, p. 36.

Orthagoriscus ozodura Harting, Verhand. Ak. Wet. Amsterd., 1868, pp. 1–48, pls. i–viii.

Ostracion hoops Richardson, Voy. Erebus and Terror, Ichth., 1844, p. 52, South Atlantic.

Head 3; depth 1⅓; D. 17; A. 16. Dorsal and anal fins high in front, rapidly decreasing backward, the height of each about 2½ in length of

body in adult; caudal fin low, with a wavy outline. Depth always more than one-half length, and in the young the vertical diameter exceeding the longitudinal. Form varying much with age, the body becoming more elongate, the fins comparatively shorter, the eye much smaller, and a hump being developed above the mouth, topped by an osseous tubercle. Dark gray; sides grayish brown with silvery reflections; belly dusky; a broad blackish bar running along the bases of the dorsal, caudal, and anal fins.

Pelagic, inhabiting most temperate and tropical seas, swimming slowly about, the high dorsal above the surface. Occasionally northward to Tokyo, England, Cape Cod, San Francisco; rare in the West Indies. It reaches a weight of 300 to 1,800 pounds. Japanese specimens are occasionally taken, but only one, from Nagasaki, has been closely examined by us. This specimen has the dorsal very high, $2\frac{1}{10}$ in body. The above description is from Atlantic examples. The published figures of Japanese specimens indicate no difference.

(*Mola*, a millstone.)

8. RANZANIA Nardo.

Ranzania NARDO, Ann. Sci. Regn. Lombard., Venet., V, 1840, pp. 10, 105, (*truncatus*).

Body oblong, the depth about one-half height; skin smooth, tessellated, divided into small hexagonal scutella; caudal truncate. Otherwise essentially as in *Mola*, the size smaller. The larval forms are unknown. Pelagic.

(Named for Camillo Ranzani, of Bologna, an excellent naturalist, who was led by the variations in the form of *Mola* to an ineffective subdivision of the species in many genera.)

27. RANZANIA MAKUA Jenkins.

Ranzania makua JENKINS, Proc. Cal. Ac. Sci., 2d ser., V, October 31, 1895, pp. 780, 784, with colored plate, Pearl Harbor, near Honolulu.—JORDAN and EVERMANN, Fish. N. M. America, 1898, p. 1755, copied.

D. 17; A. 18; C. 19; P. 3. Depth $2\frac{1}{3}$ in length to base of caudal; head $2\frac{5}{8}$; eye 6 in head, $2\frac{1}{3}$ in snout.

Body much compressed, the ventral margin a sharp, evenly curved keel. Eye much above axis of body, a little nearer snout than base of pectoral. Teeth forming a turtle-like beak completely hidden by projecting folds of skin, which form a truncated opening to the mouth. Gill opening just in front of upper base of pectoral, covered by a 2-lobed valve. Body covered by an armor of small plates, more or less hexagonal and concealed. Pectoral about $1\frac{1}{2}$ in head, above axis of body; height of dorsal about equal to head; anal slightly lower; dorsal and anal each separated from the caudal by a notch. Color bright silvery on sides, upper parts dark; sides with brighter silvery

bands, the first 3 with distinct black borders, the next 4 with numerous black spots, the black margins appearing only on lower parts.

Differing from *Ranzania truncata* chiefly in the smaller eye, in having the eye placed well above the mouth and above the axis of the body, in the high position of the pectoral fin, in the higher dorsal and anal, and in the coloration. Originally known from one specimen in Leland Stanford Junior University Museum, 20 inches long, taken at the mouth of Pearl Harbor, Oahu, by Mr. Hiel Kapu, and sent to Stanford University by Mr. Charles B. Wilson. A second example about 4 inches long was secured by the senior author at Honolulu during the summer of 1901.

It is rarely taken in Japan. In a collection of old paintings belonging to Count Daté, examined by us in Sendai, is a fine colored figure of this species with the legend in Japanese, "Off the Sea of Akabane in Mikawa by Sokichi Minake." The picture was made about 1850. The coloration is rather more spotty than in the type of *Ranzania makua*.

(*Makua*, the native name of the fish, meaning "the source from which the Bonito and the Albacore sprung in ages past.")

RECAPITULATION.

Suborder GYMNODONTES.

Family I. TRIODONTIDÆ.

1. *Triodon* Reinwardt.
   1. *bursarius* Reinwardt; Misaki.

Family II. TETRAODONTIDÆ.

2. *Spheroides* Lacépède.
   - § *Lagocephalus* Swainson.
     2. *sceleratus* (Forster).
     3. *spadiceus* (Richardson); Tokyo, Nagasaki.
     4. *stictonotus* (Schlegel); Hakodate, Misaki, Nagasaki.
     5. *inermis* (Schlegel).
     6. *porphyreus* (Schlegel).
     7. *rubripes* (Schlegel); Tokyo, Wakanoura.
     8. *xanthopteris* (Schlegel).
     9. *pardalis* (Schlegel); Hakodate, Aomori, Matsushima, Tokyo, Misaki, Onomichi, Nagasaki.
     10. *abbotti* Jordan and Snyder; Tokyo.
     11. *exascurus* Jordan and Snyder; Misaki.
     12. *ocellatus* (Osbeck).
     13. *alboplumbeus* (Richardson); Aomori, Wakanoura, Onomichi, Tsuruga.
     14. *vermicularis* (Schlegel); Tokyo, Misaki, Kobe, Tsuruga, Nagasaki.
     15. *borealis* Jordan and Snyder; Otaru, Mororan, Hakodate, Aomori, Samé, Matsushima.
     16. *niphobles* Jordan and Snyder; Tokyo, Misaki, Wakanoura, Tsuruga, Nagasaki.
   - § *Spheroides*.

17. *richei* (Fréminville).
18. *chrysops* (Hilgendorf); Tokyo, Misaki.

3. *Tetraodon* Linnæus.

§ *Tetraodon.*

19. *firmamentum* (Schlegel).

§ *Ovoides* Duméril.

20. *aërostaticus* (Jenyns); Misaki.
21. *hispidus* Linnæus; Okinawa, Ishigaki.
22. *meleagris* Lacépède; Okinawa.

Family III. TROPIDICHTHYIDÆ.

4. *Eumycterias* Jenkins.

23. *rivulatus* (Schlegel); Tokyo, Misaki, Wakanoura, Kobe, Nagasaki.

Family IV. DIODONTIDÆ.

5. *Diodon* Linnæus.

24. *holacanthus* Linnæus; Misaki, Wakanoura.

6. *Chilomycterus* Bibron.

25. *californiensis* Eigenmann; Tokyo.

Family V. MOLIDÆ.

7. *Mola* Cuvier.

26. *mola* (Linnæus); Tokyo.

8. *Ranzania* Nardo.

27. *makua* Jenkins; Akabane.